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(54) **SYSTEM FOR TRANSMITTING REFERENCE SIGNAL WITH INFORMATION ON STATE OF CHANNEL**

(75) Inventors: **Hee Soo Lee**, Daejeon (KR); **Tae Gyun Noh**, Daejeon (KR); **Jae Young Ahn**, Daejeon (KR); **Kyoung Seok Lee**, Daejeon (KR); **Young Jo Ko**, Daejeon (KR)

(73) Assignee: **Electronics and Telecommunications Research Institute**, Daejeon-si (KR)

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(Continued)

(52) **U.S. Cl.**
CPC ***H04L 5/0048*** (2013.01); *H04B 7/2606* (2013.01); *H04L 5/0091* (2013.01); *H04W 72/042* (2013.01); *H04W 84/047* (2013.01)

(58) **Field of Classification Search**
CPC H04W 72/0406; H04W 72/04; H04W 72/085; H04W 84/047; H04W 72/042;
(Continued)

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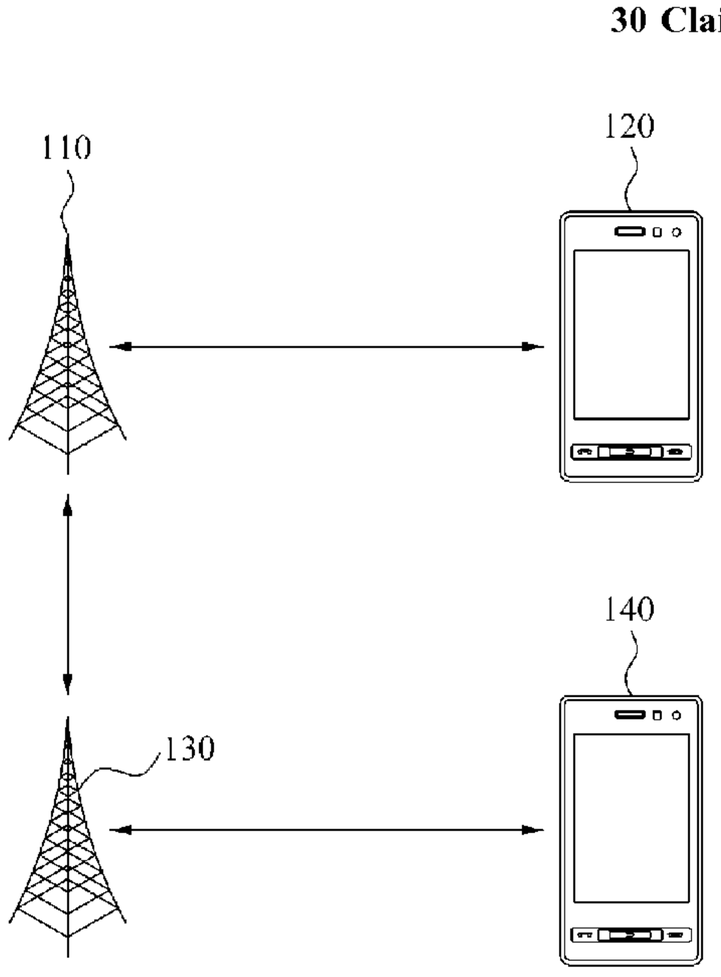
Primary Examiner — Wutchung Chu

(57) **ABSTRACT**

A reference signal (RS) transmission system to transmit a channel state information (CSI) RS for extraction of CSI to a relay and a macro terminal is disclosed. The base station transmits information on a sub frame containing the CSI RS to the relay or the macro terminal. The macro terminal and the relay receive the CSI RS using the information on the sub frame. The macro terminal and the relay extract the CSI using the CSI RS and transmit the extracted CSI to the base station.

30 Claims, 9 Drawing Sheets



(30) **Foreign Application Priority Data**

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(51) **Int. Cl.**

H04B 7/04	(2006.01)
H04W 24/10	(2009.01)
H04W 72/04	(2009.01)
H04L 5/00	(2006.01)
H04B 7/26	(2006.01)
H04W 84/04	(2009.01)

(58) **Field of Classification Search**

CPC ... H04L 1/0026; H04L 1/0027; H04L 1/1607; H04L 1/1671; H04L 5/0053; H04L 5/0048; H04L 5/0057; H04L 5/00; H04L 5/005; H04L 5/0051; H04L 5/0091; H04L 25/0224; H04B 7/2606

USPC 455/450, 509, 452.1, 68, 69; 370/236, 370/252, 431–457, 310–338

See application file for complete search history.

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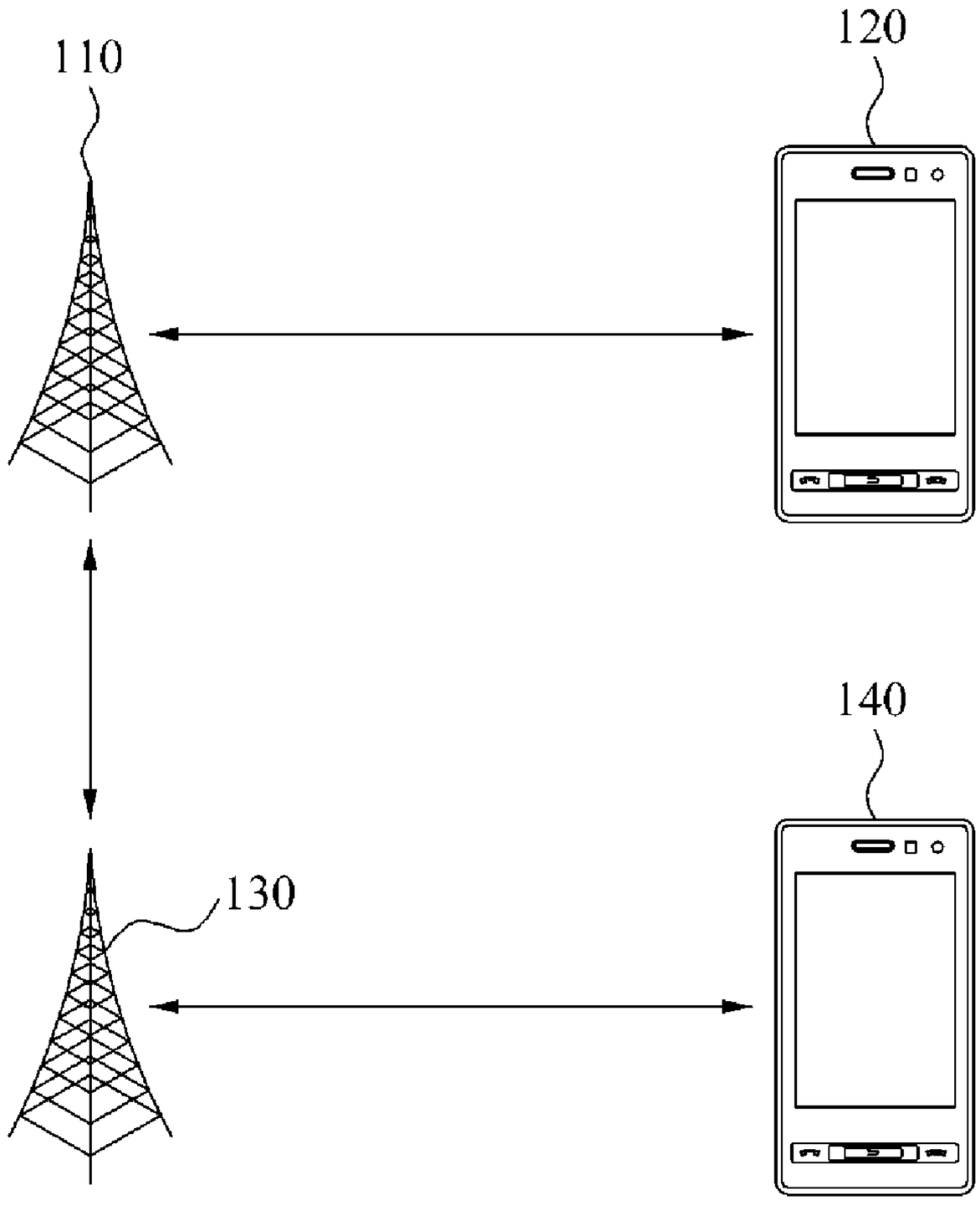
FIG. 1



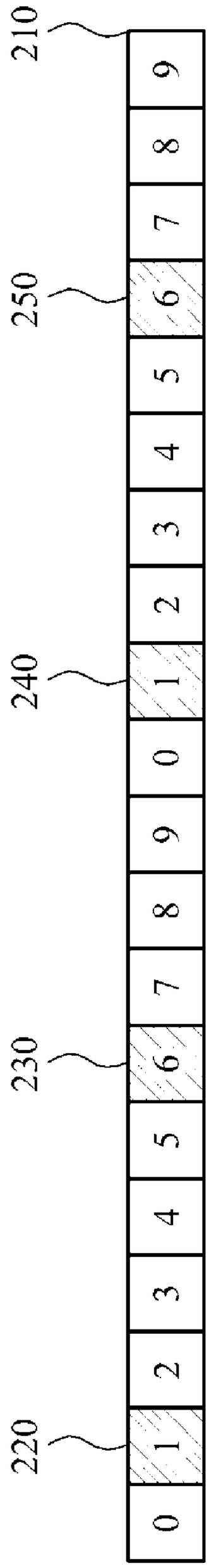


FIG. 2

FIG. 3

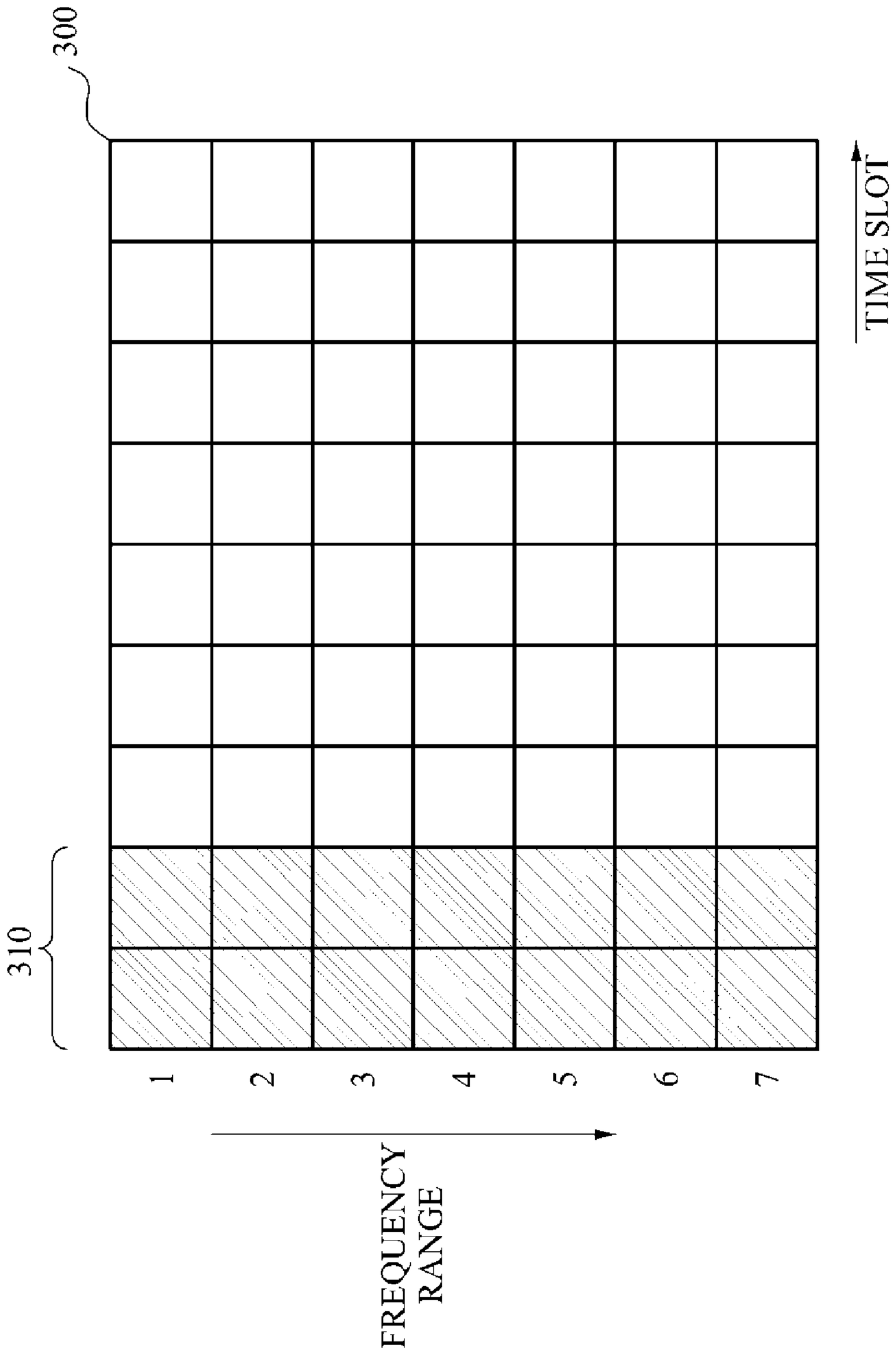
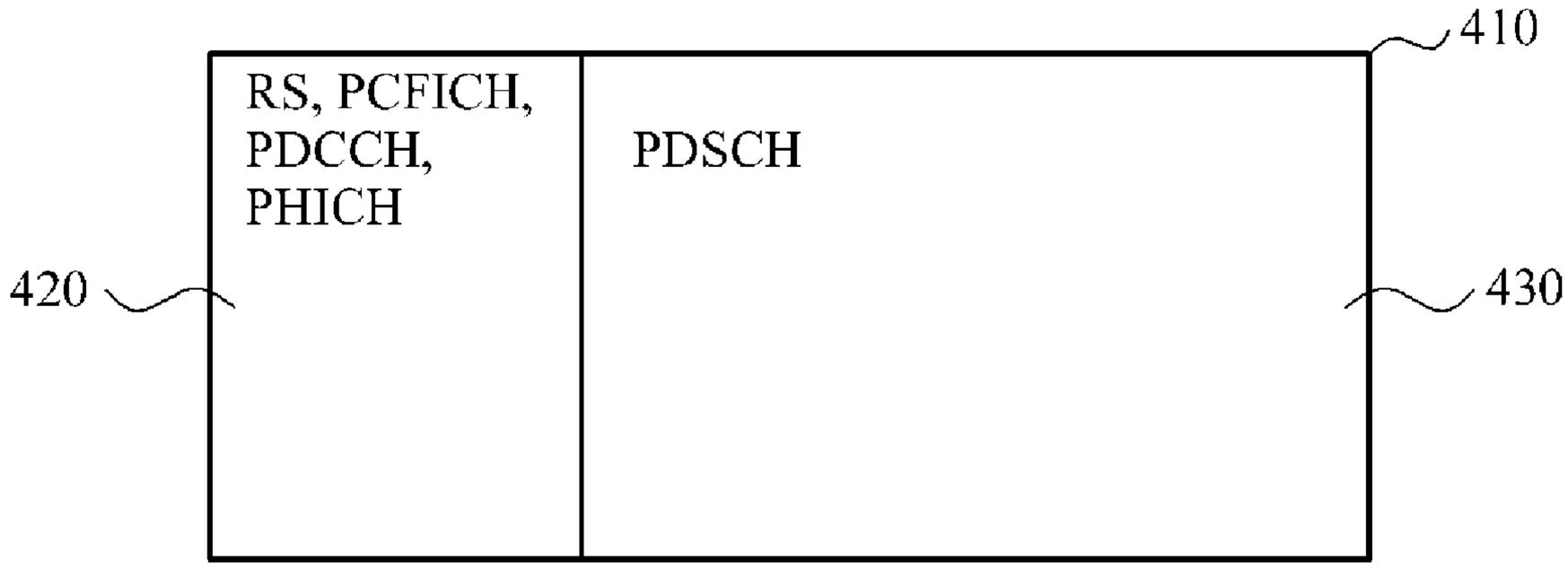
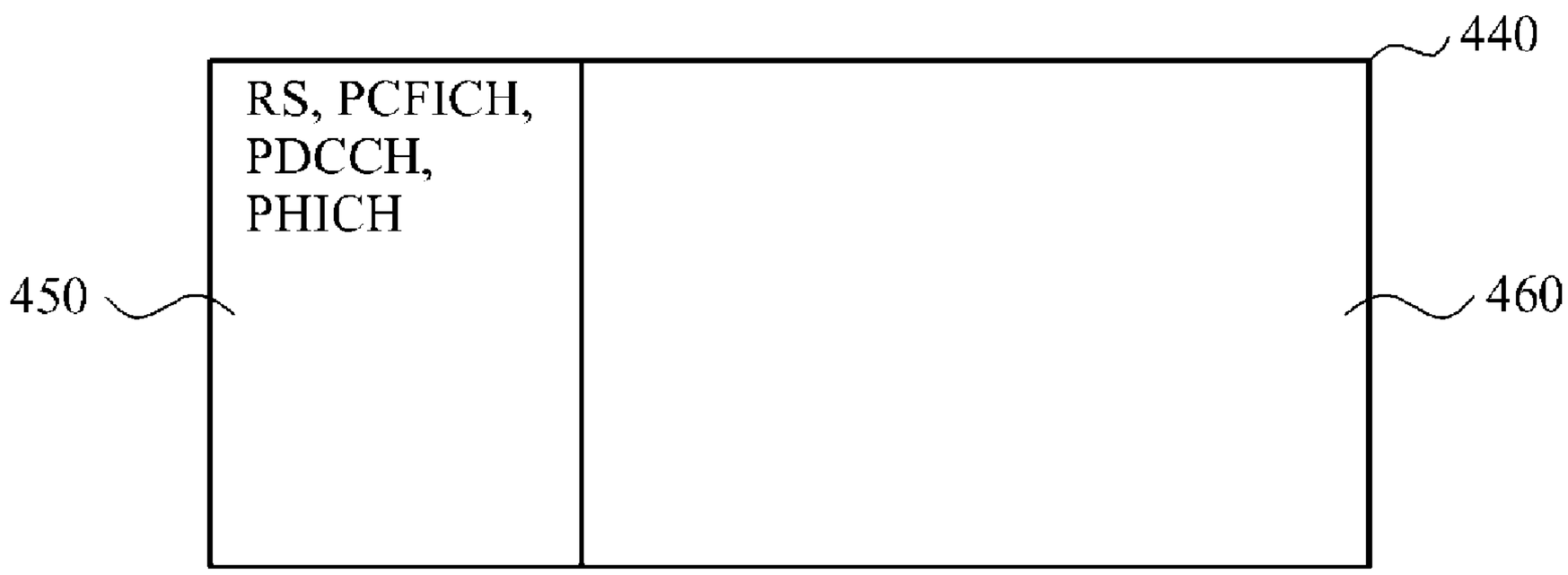


FIG. 4


410
RS, PCFICH,
PDCCH,
PHICH
PDSCH
420
430

(a)


440
RS, PCFICH,
PDCCH,
PHICH
450
460

(b)

FIG. 5

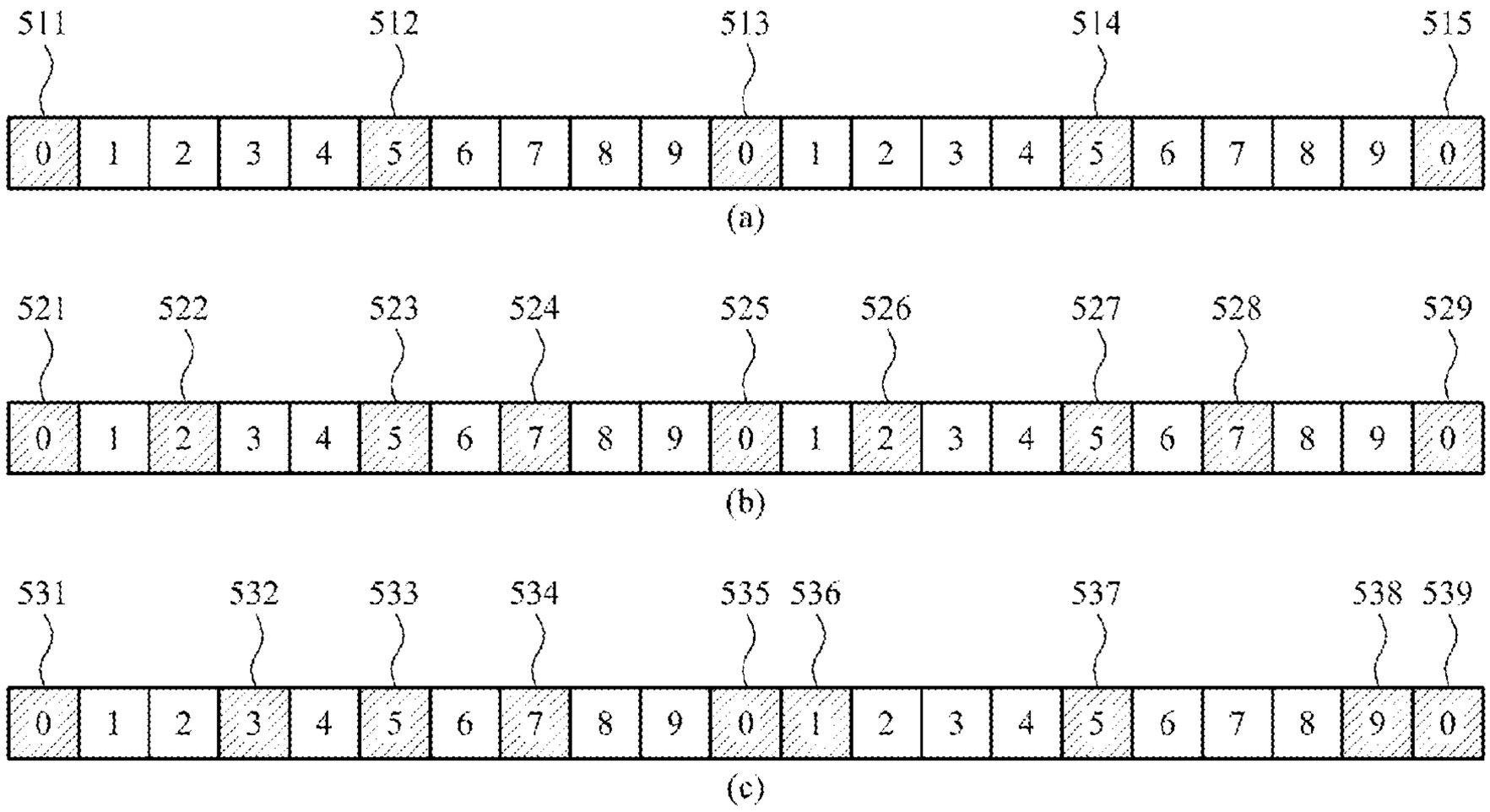

511
512
513
514
515
0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0
(a)
521
522
523
524
525
526
527
528
529
0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0
(b)
531
532
533
534
535
536
537
538
539
0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0
(c)

FIG. 6


RS,
PDCCH,
PHICH,
PCFICH
661
662
630
663
664
640
665
666
667
650
610
620

FIG. 7

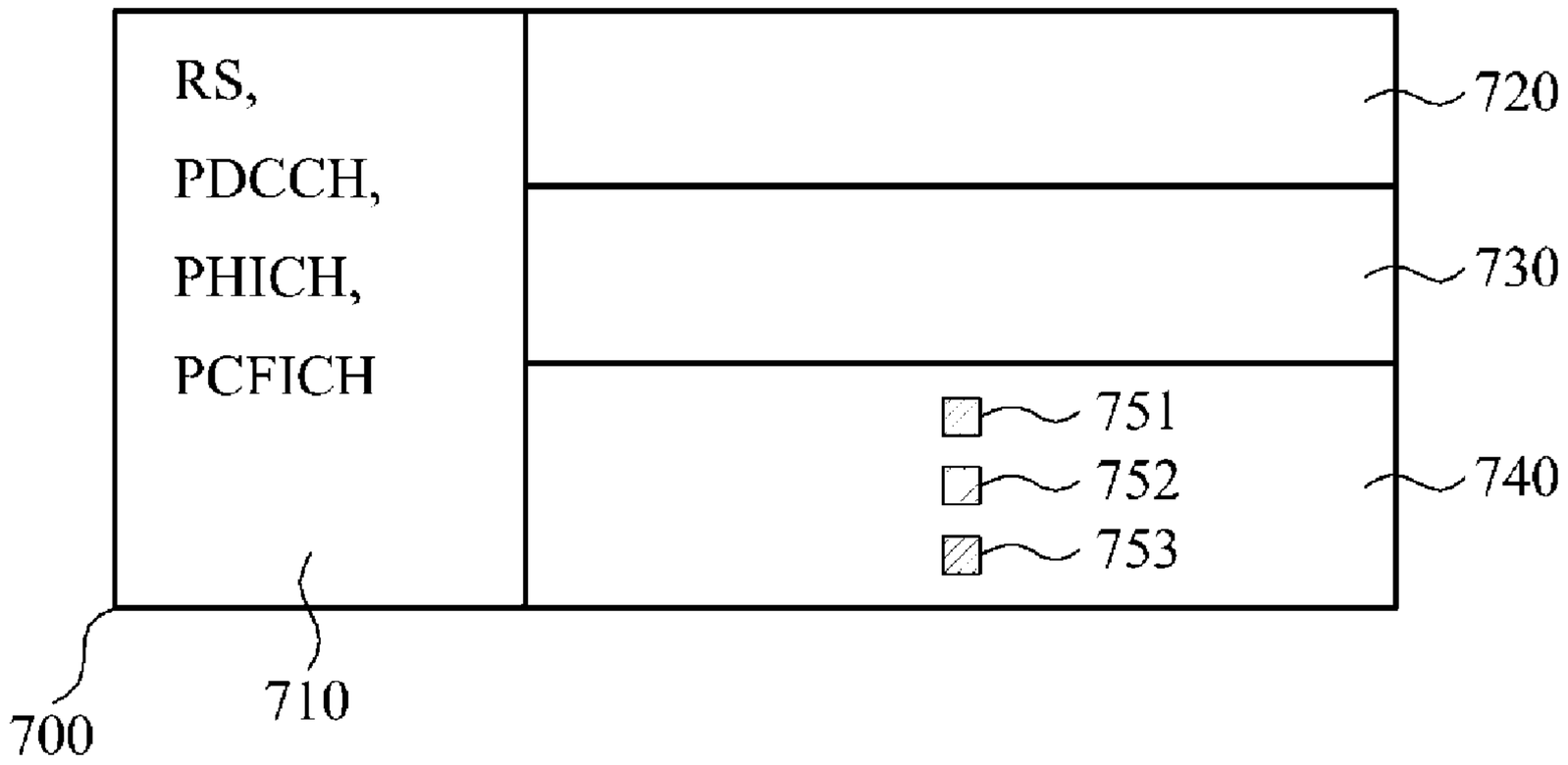

RS,
PDCCH,
PHICH,
PCFICH
720
730
751
752
753
740
700
710

FIG. 8

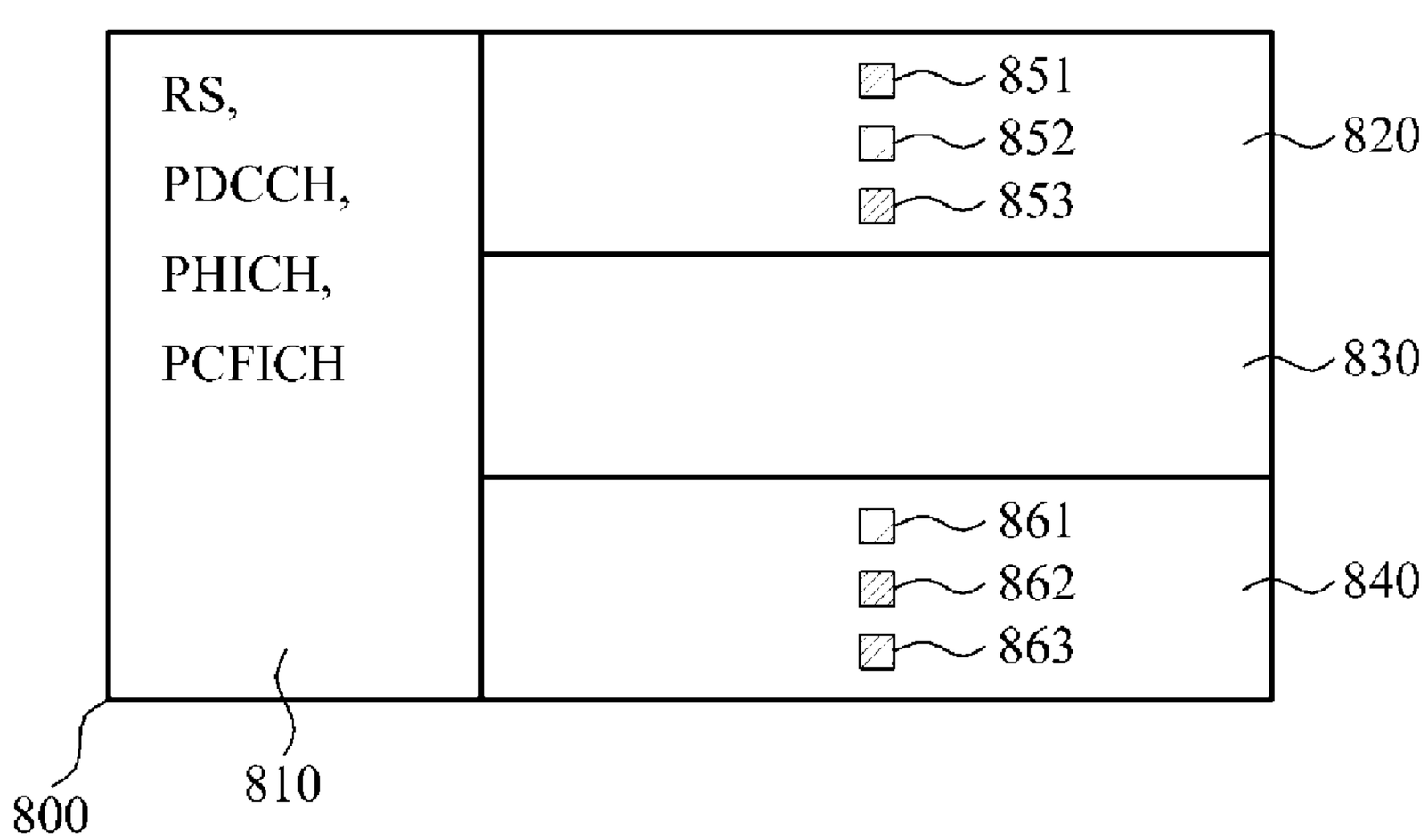
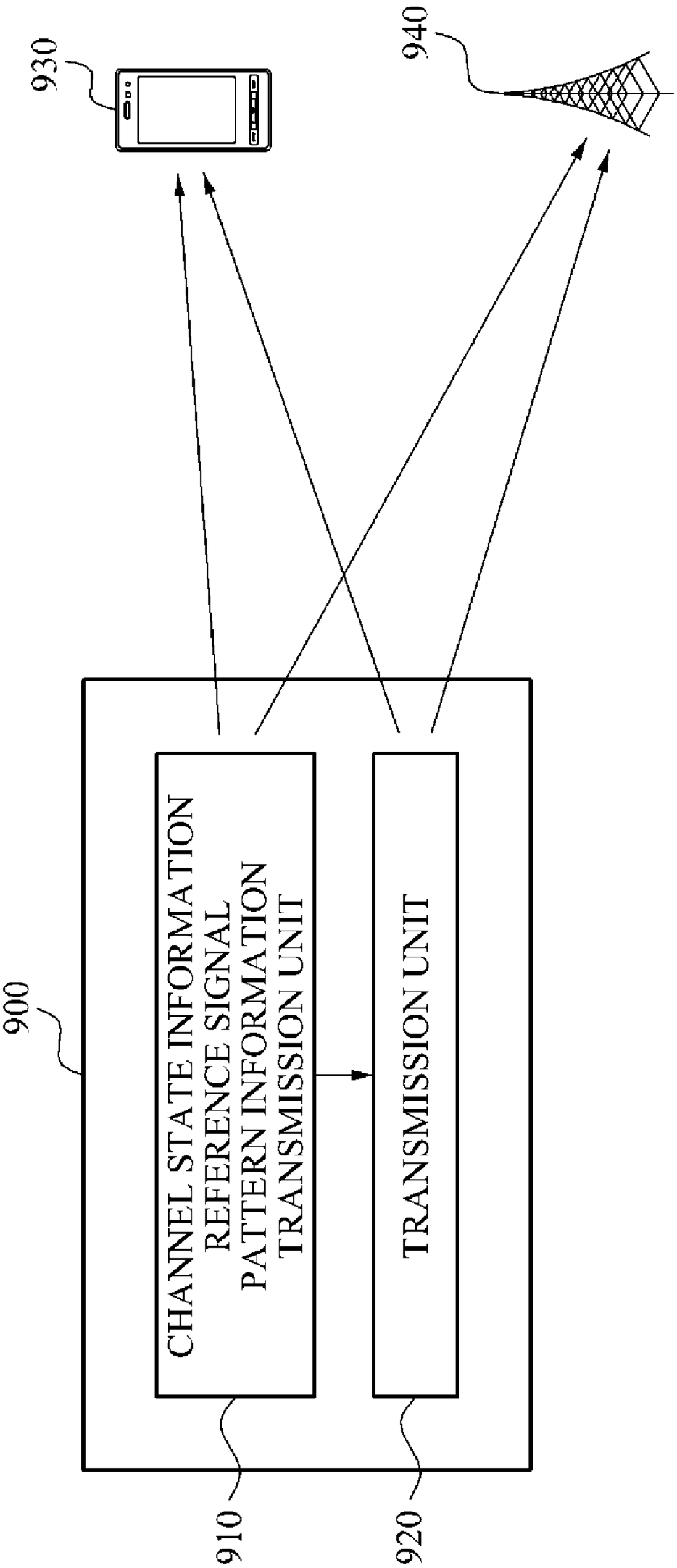

RS,
PDCCH,
PHICH,
PCFICH
851
852
853
820
830
861
862
863
840
800
810

FIG. 9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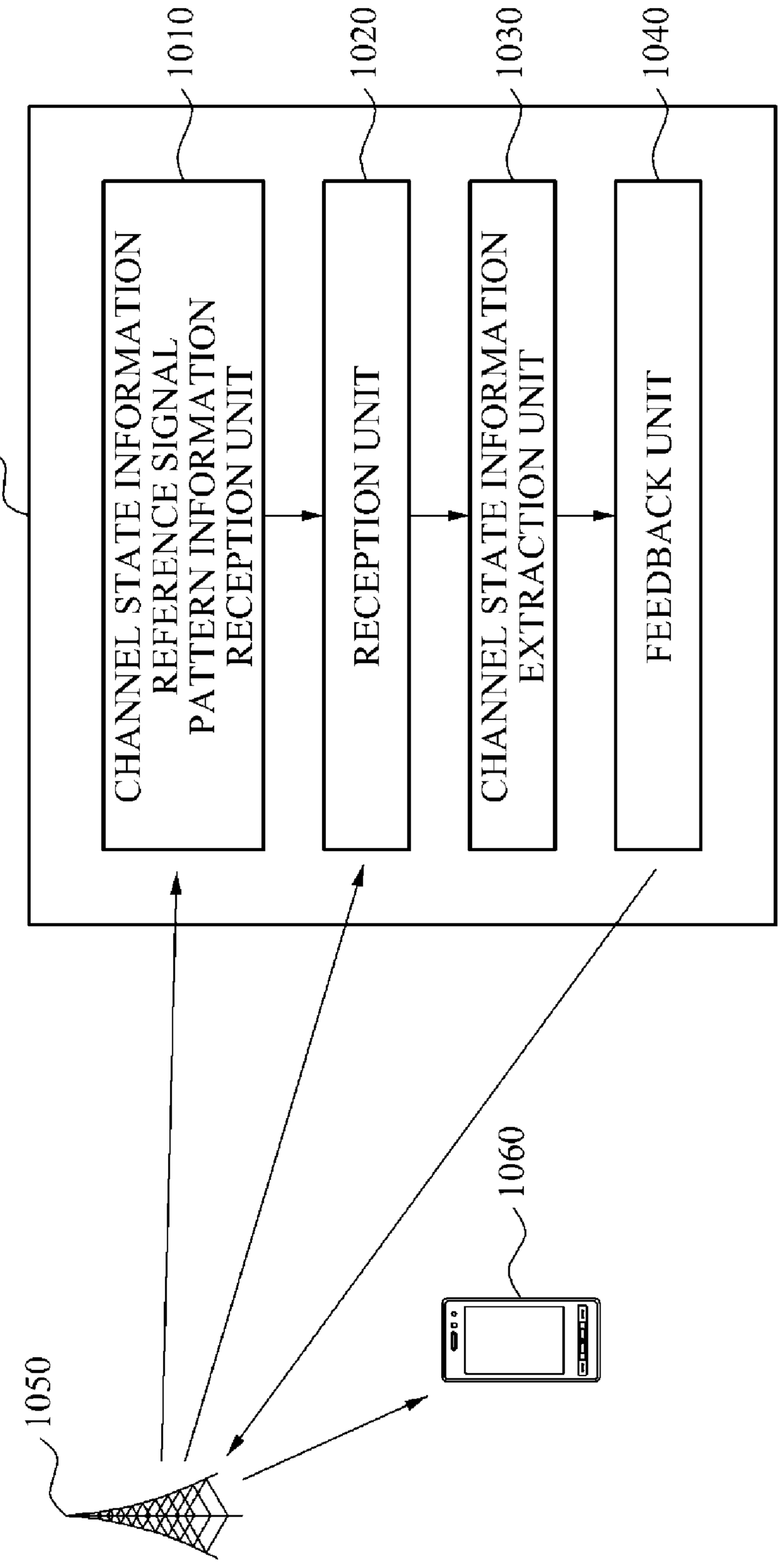
TRANSMISSION UNIT
910
920

FIG. 10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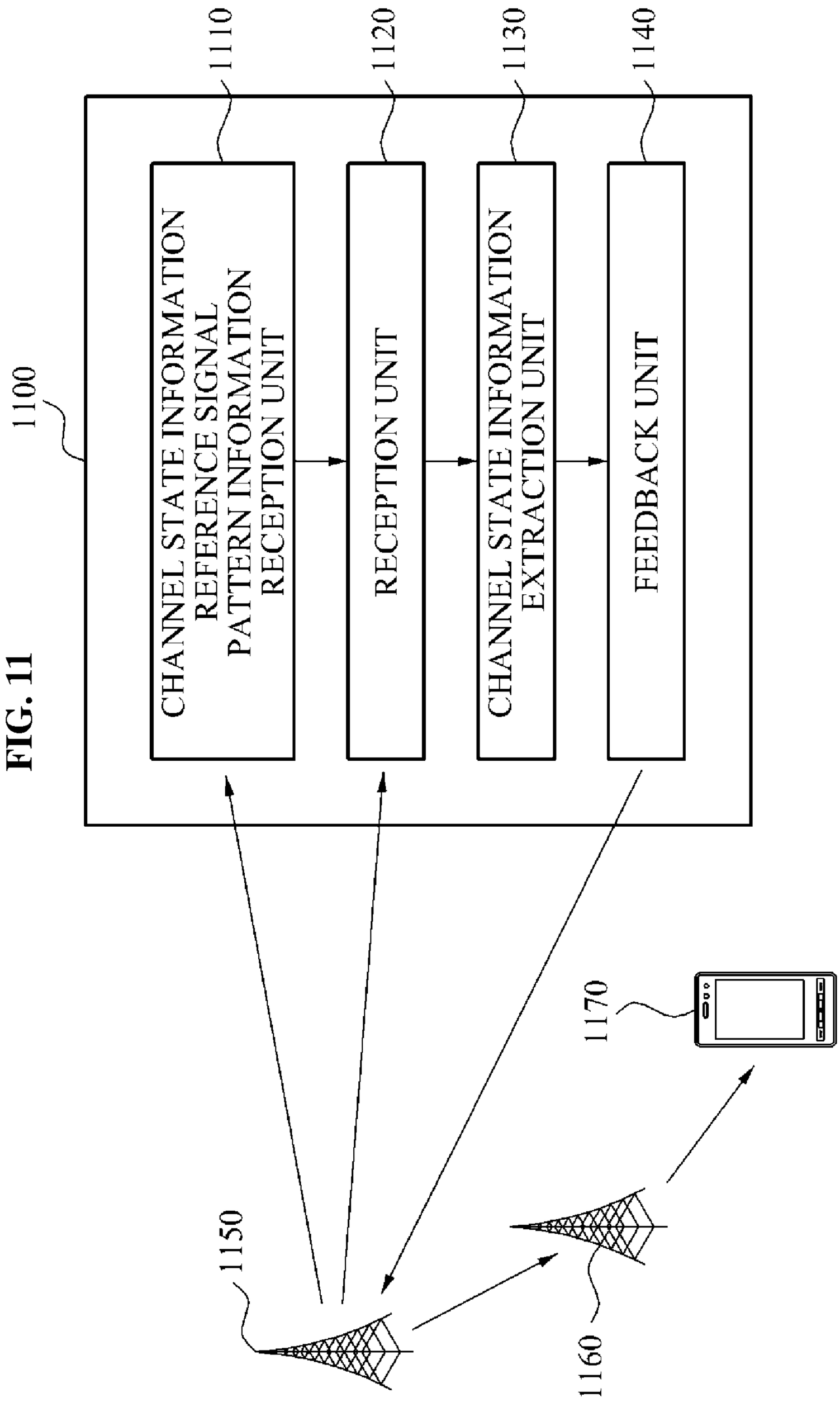
1010
1020
1030
1040
CHANNEL STATE INFORMATION REFERENCE SIGNAL PATTERN INFORMATION RECEPTION UNIT
RECEPTION UNIT
CHANNEL STATE INFORMATION EXTRACTION UNIT
FEEDBACK UNIT
1050
1060

FIG. 11


1100
1110
1120
1130
1140
CHANNEL STATE INFORMATION REFERENCE SIGNAL PATTERN INFORMATION RECEPTION UNIT
RECEPTION UNIT
CHANNEL STATE INFORMATION EXTRACTION UNIT
FEEDBACK UNIT
1150
1160
1170

SYSTEM FOR TRANSMITTING REFERENCE SIGNAL WITH INFORMATION ON STATE OF CHANNEL

RELATED APPLICATIONS

This application is a continuation of PCT Application No. PCT/KR2010/001696 filed on Mar. 18, 2010, which claims priority to, and the benefit of, Korean Patent Application No. 10-2009-0023257 filed Mar. 18, 2009, Korean Patent Application No. 10-2009-0024128 filed Mar. 20, 2009, Korean Patent Application No. 10-2009-0024275 filed Mar. 23, 2009, and Korean Patent Application No. 10-2009-0094999 filed Oct. 7, 2009. The contents of the aforementioned applications are hereby incorporated by reference.

BACKGROUND

The present invention relates to a reference signal (RS) necessary for data transmission and reception and to signaling of the RS, and more particularly, to an RS signal for data transmission and reception between a base station and a relay in a wireless communication system using the relay and signaling of the RS.

An appropriate reference signal (RS) needs to be transmitted for efficient transmission and reception of data. The RS is necessary for modulation of data and also for generation of channel state information (CSI) through estimation of a channel state between a base station and a terminal. The terminal generates CSI and transmits the CSI to the base station. The base station transmits data to the terminal based on the CSI. An RS used to extract the CSI may be referred to as a 'CSI RS.'

A plurality of RSs are necessary in general for multiple input multiple output (MIMO) transmission and reception. Exemplarily, the RSs transmitted by the base station are orthogonal to one another. The base station transmits its own specific RS to all terminals in the coverage. In general, as the number of antennas installed in the base station increases, more RSs are necessary.

SUMMARY

An aspect of the present invention provides a method to transmit a channel state information (CSI) reference signal (RS) for data transmission between a base station and a relay in a system which uses the relay.

According to an aspect of the present invention, there is provided a base station which transmits sub frames to a terminal and a relay, including a channel state information (CSI) reference signal (RS) pattern information transmission unit to transmit information on a sub frame which contains a CSI RS among the sub frames to the terminal or the relay; and a transmission unit to transmit the CSI RS and data to the terminal or the relay with reference to the information on the sub frame.

According to an aspect of the present invention, there is provided a relay including a CSI RS pattern information reception unit to receive, from a base station, information on a sub frame which contains a CSI RS; a reception unit to receive the CSI RS from the base station with reference to the information on the sub frame; a CSI extraction unit to extract CSI between the base station and the relay using the CSI RS; and a feedback unit to transmit the extracted CSI to the base station.

According to an aspect of the present invention, there is provided a terminal including a CSI RS pattern information reception unit to receive, from a base station, information on a sub frame which contains a CSI RS; a reception unit to receive the CSI RS from the base station with reference to the information on the sub frame; a CSI extraction unit to extract CSI between the base station and the relay using the CSI RS; and a feedback unit to transmit the extracted CSI to the base station.

According to the embodiments of the present invention, the CSI RS for data transmission between the base station and the relay in a system using a relay may be efficiently transmitted.

BRIEF DESCRIPTION OF DRAWINGS

FIG. **1** is a view for describing a reference signal (RS) transmission system;

FIG. **2** is a view showing a multicast broadcast single frequency network (MBSFN) sub frame according to an embodiment of the present invention;

FIG. **3** is a view showing the structure of the MBSFN sub frame according to the embodiment;

FIG. **4** is a view showing the structures of sub frames of a base station and a relay in a case where the relay receives data transmitted by the base station;

FIG. **5** is a view showing sub frames containing an RS according to an embodiment of the present invention;

FIG. **6** is a view showing an RS located in a frequency range according to an embodiment;

FIG. **7** is a view showing an RS located in a frequency range according to another embodiment;

FIG. **8** is a view showing an RS located in a frequency range according to still another embodiment;

FIG. **9** is a block diagram showing the structure of the base station according to an embodiment of the present invention;

FIG. **10** is a block diagram showing the structure of the relay according to an embodiment of the present invention; and

FIG. **11** is a block diagram showing the structure of a terminal according to an embodiment of the present invention.

DESCRIPTION OF EMBODIMENTS

Reference will now be made in detail to embodiments of the present invention, examples of which are illustrated in the accompanying drawings, wherein like reference numerals refer to the like elements throughout. The embodiments are described below in order to explain the present invention by referring to the figures.

FIG. **1** is a view for describing a reference signal (RS) transmission system according to an embodiment of the present invention.

The RS transmission system includes a base station **110**, a relay **130**, a macro terminal **120**, and a relay terminal **140**. The macro terminal **120** receives data directly from the base station **110** by connecting directly with the base station **110**. The relay terminal **140** connects with the relay **130** and receives data from the relay **130**. The relay **130** receives data from the base station **110** and forwards the received data to the relay terminal **140**.

The RS transmission system also includes an uplink and a downlink between the base station **110** and the terminal **120**, an uplink and a downlink between the base station **110** and the relay **130**, and an uplink and a downlink between the

relay **130** and the relay terminal **140**. In the RS transmission system, the six links need to efficiently allocate and use limited system resources.

FIG. **2** is a view showing a multicast broadcast single frequency network (MBSFN) sub frame according to an embodiment of the present invention.

The relay **130** informs, by a signal, terminals that a sub frame used for reception of a signal from the base station **110** is the MBSFN sub frame.

As shown in FIG. **2**, each of frames **210** may include ten sub frames. The relay **130** may designate first frames and sixth frames **220**, **230**, **240**, and **250** of the frames **210** as the MBSFN sub frames. The relay **130** may receive data from the base station **110** using the MBSFN sub frames **220**, **230**, **240**, and **250** and forward data to the relay terminal **140** using sub frames other than the MBSFN sub frames **220**, **230**, **240**, and **250**.

FIG. **3** is a view showing the structure of the MBSFN sub frame according to the embodiment.

In FIG. **3**, a horizontal axis denotes an elapse of time while a vertical axis denotes a frequency range. A sub frame **300** signaled as the MBSFN sub frame to receive data from the base station may transmit control signals using part of symbols **310** located at a front portion of the sub frame **300**. Here, the control signals may include an RS, a physical control format indicator channel (PCFICH), a physical downlink control channel (PDCCH), and a Physical H-ARQ Indicator Channel (PHICH). The relay receives signals from the base station using the other slots of the sub frame **300**.

FIG. **4** shows the structures of the sub frames of the base station and of the relay in a case where the relay receives data transmitted by the base station.

Part (a) of FIG. **4** shows the structure of a downlink sub frame **410** transmitted by the base station **110** to the macro terminal **120** and the relay **130**.

The sub frame **410** includes a control signal region **420** and data regions **430**. The base station **110** may transmit the RS, the PCFICH, the PDCCH, and the PHICH using the control signal region **420** and transmit a physical downlink shared channel (PDSCH) using the data region **430**. The control signal region **420** may consist of the symbols of the front part of the sub frame as shown in FIG. **3**.

Part (b) of FIG. **4** shows the structure of a downlink sub frame **440** transmitted by the relay **130** to the relay terminal **140**. The relay **130** provides a signal that the downlink sub frame **440** corresponding to the sub frame **410** of the base station **110** is the MBSFN sub frame. The downlink sub frame **440** set to receive a signal from the base station includes a control signal region **450** and a reception region **460**. The relay **130** may transmit the RS, the PCFICH, the PDCCH, and the PHICH using the control signal region **450** for the relay **140** that receives data from the relay **130**. The relay **130** receives data from the base station **110** but does not transmit data to the relay terminal **140** for a time corresponding to the reception region **460**.

FIG. **5** shows sub frames containing a CSI RS according to an embodiment of the present invention.

The CSI RS may not be contained in all sub frames. In other words, only some of the sub frames transmitted by the base station **110** to the macro terminal **120** or the relay **130** may include the CSI RS. The macro terminal **120** or the relay **130** receives the CSI RS and estimates a state of channel between the base station **110** and the macro terminal **120** or between the base station **110** and the relay **130** using the CSI RS.

Since not all the sub frames contain the CSI RS, the macro terminal **120** and the relay **130** need to be aware of which sub frame contains the CSI RS. That is, the macro terminal **120** and the relay **130** need to be aware of a transmission pattern of the CSI RS.

The base station **110** informs the macro terminal **120** and the relay **130** of the transmission pattern of the CSI RS by signals. Therefore, the macro terminal **120** and the relay **130** may receive the CSI RS from the base station **110** based on the transmission pattern.

According to an embodiment, the base station **110** may periodically transmit the CSI RS. For example, all the base stations may have the same CSI RS transmission period. All the base stations may transmit the CSI RS using different sub frames and using cell specific offsets while transmitting the CSI RS by the same transmission period. In this case, the CSI RS pattern information may include the CSI RS transmission period and offset.

Presuming that θ_a denotes an offset of a base station A and n_f and n_s denote a frame number and a sub frame number, respectively, the sub frame number may represent an order of a plurality of sub frames of a frame. The base station A may transmit the CSI RS only in a sub frame satisfying [Expression 1] below, wherein N denotes the number of sub frames included in one frame and Δ denotes the CSI RS transmission period.

$$\theta_a=(n_f*N+n_s)\bmod \Delta \qquad \text{[Expression 1]}$$

According to an embodiment, all the base stations may have the same or different offsets θ. The offset θ and the CSI RS transmission period Δ may vary over time. The base station may transmit the offset θ to the macro terminal **120** and the relay **130**. The macro terminal **120** and the relay **130** may receive the CSI RS based on the offset θ and the CSI RS transmission period Δ.

Part (a) of FIG. **5** illustrates transmission of the CSI RS using the sub frames in a case where the offset θ is '0' and the CSI RS transmission period Δ is '5'. Sub frames **511**, **512**, **513**, **514**, and **515**, hatched in the drawing, contain the CSI RS.

According to an embodiment, the base station **110** may transmit the CSI RS using a set of one or more uniform-spaced sub frames. For example, presuming that $S(\Delta,\theta)$ denotes a set of the uniform-spaced sub frames of which the transmission period is denoted by Δ and the offset is denoted by θ, the base station **110** may transmit the CSI RS using the sub frames belonging to a union U of [Expression 2] below. In this case, the base station **110** informs the macro terminal **120** and the relay **130** of the CSI RS pattern information including one or more offsets. In other words, the CSI RS pattern information includes $(\theta_1, \theta_2, \theta_3, \ldots, \theta_N)$.

$$U=\cup_{i=1}^{N} S(\Delta,\theta_i) \qquad \text{[Expression 2]}$$

When there is an offset vector $(\theta_1, \theta_2, \theta_3, \ldots, \theta_N)$, the base station **110** transmits the CSI RS to the sub frames belonging to the set of [Expression 2].

Part (b) of FIG. **5** shows transmission of the CSI RS when an offset vector $\{\theta_1=0, \theta_2=2\}$ is provided. The transmission period corresponding to each element of the offset vector is '5'. Sub frames **521**, **522**, **523**, **524**, **525**, **526**, **527**, **528**, and **529**, hatched in the drawing, contain the CSI RS.

According to an embodiment, the transmission period corresponding to each element of the offset vector may be different. That is, the base station **110** may transmit the CSI RS to sub frames belonging to a union U of [Expression 3] below with respect to a period vector $(\Delta_1, \Delta_2, \Delta_3, \ldots, \Delta_N)$ and an offset vector $(\theta_1, \theta_2, \theta_3, \ldots, \theta_N)$. In this case, the base station **110** may generate the CSI RS pattern information including at least one period and at least one offset and

inform the macro terminal **120** and the relay **130** of the CSI RS pattern information by signals.

$$S(\Delta_1,\Delta_2,\Delta_3,\ldots,\Delta_N,\theta_1,\theta_2,\theta_3,\ldots,\theta_N)=\cup_{i=1}^{N}S(\Delta_i,\theta_i) \quad \text{[Expression 3]}$$

Part (c) of FIG. **5** shows transmission of the CSI RS in a case where a period vector is {5,4} and an offset vector is $\{\theta_1=0, \theta_2=3\}$. Hatched sub frames **531**, **532**, **533**, **534**, **535**, **536**, **537**, **538**, and **539** contain the CSI RS.

According to an embodiment, the period vector or the offset vector with respect to a plurality of the base stations may be equal or different.

According to an embodiment, the base station **110** may transmit a signal regarding the CSI RS transmission period Δ or the offset θ of the CSI RS to the macro terminal **120** or the relay **130** using a control channel (CCH).

According to an embodiment, the base station **110** may transmit those parameters to the macro terminal **120** and the relay **130** periodically or only when the parameters are changed.

According to an embodiment, in the case where the CSI RS is periodically transmitted, the system may be set so that the CSI RS is not transmitted to certain predetermined sub frames. For example, if the sub frames satisfy conditions disclosed below, the CSI RS may be not transmitted to the predetermined sub frames even when the predetermined sub frames correspond to the period for transmitting the CSI RS.

1) MBSFN sub frames designated for a multimedia broadcast multicast service (MBMS) service

2) downlink sub frames used as a backhaul link for data reception

According to an embodiment, position information of the sub frames which are set to be not transmitted with the CSI RS may be transmitted to the macro terminal **120** and the relay **130** regardless of the period.

According to an embodiment, the base station **110** may inform the macro terminal **120** and the relay **130** of the MBSFN sub frames used by the MBMS service.

According to an embodiment, the base station **110** may inform the macro terminal **120** and the relay **130** of the downlink sub frames used as the backhaul link for data reception.

The CSI RS may be used for data transmission and reception between the base station **110** and the relay **130**. Among the sub frames transmitted by the base station **110**, the relay **130** may receive only specific sub frames allocated for a link between the base station **110** and the relay **130**. Therefore, if there is no CSI RS in the sub frame allocated for the link between the base station **110** and the relay **130**, the relay **130** receives no CSI RS. Accordingly, the base station **110** is limited in determining the sub frame to transmit the CSI RS.

According to an embodiment, the base station **110** may not be able to periodically allocate the sub frame to transmit the CSI RS. In this case, the sub frame to transmit the CSI RS may be determined and a position of the determined sub frame may be transmitted to the macro terminal **120** or the relay **130** using bitmap information. That is, the base station **110** transmits the information on the sub frame containing the CSI RS in the form of the bitmap to the macro terminal **120** or the relay **130**. The bitmap information may represent whether each of the sub frames contains the CSI RS. For example, it may be considered that the sub frame corresponding to the bitmap information contains the CSI RS when a value of the bitmap information is '1' and does not contain the CSI RS when a value of the bitmap information is '0.' Here, the CSI RS pattern information may contain the bitmap information representing whether the CSI RS is transmitted.

According to an embodiment, the base station **110** may transmit an identifier list of the sub frame to transmit the CSI RS to the macro terminal **120** or the relay **130**.

According to an embodiment, the base station **110** may transmit information on whether an (n+k)-th sub frame contains the CSI RS to the macro terminal **120** and the relay **130** using an n-th sub frame. Here, a value 'k' may be equal to or greater than '0' and be varied based on the base stations.

For example, the base station **110** may transmit the information on whether the (n+k)-th sub frame contains the CSI RS to the macro terminal **120** using a PCFICH channel of the n-th sub frame.

Since the relay **130** is not able to receive the PCFICH channel, the base station **110** may transmit the information on whether the (n+k)-th sub frame contains the CSI RS to the relay **130** using a dedicated channel for the relay **130**. According to an embodiment, the dedicated channel may be located next to a symbol used for PDCCH transmission and for a transition gap.

According to an embodiment, the base station **110** may transmit the n-th sub frame including the value 'k.' That is, the base station **110** informs the macro terminal **120** or the relay **130** that the CSI RS is transmitted to the (n+k)-th sub frame.

Since the relay **130** is capable of receiving only part of the sub frames transmitted by the base station **110**, the relay **130** is not able to receive the CSI RS pattern information being transmitted by the base station **110** to the macro terminal **120**. The base station **110** may transmit the CSI RS pattern information to the relay **130** using the dedicated channel for the relay **130**. The dedicated channel may be a CCH relay or a downlink shared channel for the relay **130**.

The base station **110** transmits the CSI RS only in a part of the sub frames. The relay **130** may estimate the CSI RS only in a part of the sub frames. Therefore, the relay **130** is able to receive the CSI RS only when the sub frame where the base station **110** transmits the CSI RS corresponds to the sub frame where the relay **130** receives the signal of the base station **110**. The relay **130** is not able to receive the CSI RS when those sub frames do not correspond to each other.

FIG. **6** shows the CSI RS located in a frequency range, according to an embodiment of the present invention. The base station **110** transmits the CSI RS to the sub frame allocated to the link between the base station **110** and the relay **130**. The base station may be contained in all the sub frames allocated to the link between the base station **110** and the relay **130** or part of the sub frames.

FIG. **6** shows the embodiment where CSI RSs **661**, **662**, **663**, **664**, **665**, **666**, and **667** are present in all frequency ranges **630**, **640**, and **650** of a sub frame **610**.

FIG. **7** shows the CSI RS present in a frequency range, according to another embodiment. According to the embodiment shown in FIG. **7**, CSI RSs **751**, **751**, and **753** are present in only a frequency range **740** allocated to the relay **130** but not in other frequency ranges **720** and **730**.

According to an embodiment, the base station **110** may transmit the CSI RS to a plurality of relays. In this case, a frequency range may be individually allocated to each of the relays. The base station **110** may allocate the CSI RS to a union of all the frequency ranges respectively allocated for data transmission to the relays.

According to an embodiment, the base station **110** may allocate the CSI RS not only to the union of the all frequency

ranges allocated for data transmission to the relays but also to the frequency range allocated for data transmission to the macro terminal.

FIG. **8** shows the CSI RS present in a frequency range, according to still another embodiment. In the embodiment shown in FIG. **8**, the base station **110** may allocate the CSI RS only to part of frequency ranges of a downlink resource. In this case, different frequency ranges instead of all the same frequency range may be used in the all sub frames transmitting the CSI RS. In this case, the base station **110** may inform the relay **130** of which frequency range has the CSI RS.

FIG. **9** is a block diagram showing the structure of a base station according to an embodiment of the present invention.

The base station **900** includes a CSI RS pattern information transmission unit **910** and a transmission unit **920**.

The CSI RS pattern information transmission unit **910** transmits, to a macro terminal **930** or a relay **940**, information on a sub frame containing the CSI RS among all the sub frames transmitted by the transmission unit **920**. The macro terminal **930** receives data directly from the base station **900** by connecting with the base station **900**.

According to an embodiment, the macro terminal **930** extracts CSI between the base station **900** and the macro terminal **930** and feeds back the extracted CSI to the base station **900**.

According to an embodiment, the CSI RS pattern information may include at least one of an identifier list of the sub frame containing the CSI RS, the transmission period and offset of the sub frame containing the CSI RS, a bitmap with respect to the sub frame containing the CSI RS, and information on whether the CSI RS is present in a sub frame after a k-th sub frame.

According to an embodiment, the CSI RS pattern information may include position information on the sub frames set not to transmit the CSI RS regardless of a period.

According to an embodiment, the CSI RS pattern information may include the position information of the MBSFN sub frame set for the MBMS service.

According to an embodiment, the CSI RS pattern information may include position information of the downlink sub frame set for the data reception backhaul link.

According to an embodiment, the CSI RS pattern information or the information on the sub frame containing the CSI RS may be set to be the same or different with respect to a plurality of base stations.

According to an embodiment, the CSI RS pattern information transmission unit **910** may transmit the information on the sub frame containing the CSI RS to the macro terminal **930** through the CCH.

According to an embodiment, the CSI RS pattern information transmission unit **910** may transmit the information on the sub frame containing the CSI RS to the relay **940**.

The transmission unit **920** transmits the CSI RS and data to the macro terminal **930** or the relay **940** with reference to the information on the sub frame. The transmission unit **920** may not transmit the CSI RS in the MBSFN sub frame set for the MBMS service.

The transmission unit **920** may not transmit the CSI RS in the downlink sub frame used for the data reception backhaul link.

The relay **940** extracts the CSI with respect to the base station **900** using the CSI RS.

FIG. **10** is a block diagram showing the structure of a relay according to an embodiment of the present invention.

The relay **1000** includes a CSI RS pattern information reception unit **1010**, a reception unit **1020**, a CSI extraction unit **1030**, and a feedback unit **1040**.

A base station **1050** transmits the sub frame containing data to the information **1000**. Part of the sub frames transmitted by the base station **1050** may contain the CSI RS.

The CSI RS pattern information reception unit **1010** receives the information on the sub frame containing the CSI RS from the base station **1050**.

According to an embodiment, the CSI RS pattern information may include at least one of an identifier list of the sub frame containing the CSI RS, the transmission period and offset of the sub frame containing the CSI RS, a bitmap with respect to the sub frame containing the CSI RS, and information on whether the CSI RS is present in a sub frame after a k-th sub frame.

According to an embodiment, the CSI RS pattern information may include position information on the sub frames set not to transmit the CSI RS regardless of a period.

According to an embodiment, the CSI RS pattern information may include the position information of the MBSFN sub frame set for the MBMS service.

According to an embodiment, the CSI RS pattern information may include position information of the downlink sub frame set for the data reception backhaul link.

The reception unit **1020** receives the CSI RS from the base station **1050** using the information on sub frame.

The CSI extraction unit **1030** extracts the CSI between the base station **1050** and the relay **1000** using the CSI RS.

The feedback unit **1040** may feedback the extracted CSI to the base station **1050**.

The base station **1050** may transmit data directly to a macro terminal **1060** connected with the base station **1050**.

FIG. **11** is a block diagram showing the structure of a terminal according to an embodiment of the present invention.

The terminal **1100** includes a CSI RS pattern information reception unit **1110**, a reception unit **1120**, a CSI extraction unit **1130**, and a feedback unit **1140**.

The CSI RS pattern information reception unit **1110** receives the information on the sub frame containing the CSI RS from the base station **1150**.

According to an embodiment, the CSI RS pattern information may include at least one of an identifier list of the sub frame containing the CSI RS, the transmission period and offset of the sub frame containing the CSI RS, a bitmap with respect to the sub frame containing the CSI RS, and information on whether the CSI RS is present in a sub frame after a k-th sub frame.

According to an embodiment, the CSI RS pattern information may include position information on the sub frames set not to transmit the CSI RS regardless of a period.

According to an embodiment, the CSI RS pattern information may include the position information of the MBSFN sub frame set for the MBMS service.

According to an embodiment, the CSI RS pattern information may include position information of the downlink sub frame set for the data reception backhaul link.

According to an embodiment, the CSI RS pattern information reception unit **1110** may receive the information on the sub frame through the CCH.

The reception unit **1120** receives the CSI RS from the base station **1150** using the information on sub frame.

The CSI extraction unit **1130** extracts the CSI between the base station **1050** and the relay **1100** using the CSI RS.

The feedback unit **1140** may feedback the extracted CSI to the base station **1150**.

The base station **1150** may transmit data directly to a macro terminal **1160** connected with the base station **1150**. The relay **1160** may forward the data received from the base station **1150** to a relay terminal **1170** connected with the relay **1160**.

Although a few embodiments of the present invention have been shown and described, the present invention is not limited to the described embodiments. Instead, it would be appreciated by those skilled in the art that changes may be made to these embodiments without departing from the principles and spirit of the invention, the scope of which is defined by the claims and their equivalents.

The invention claimed is:

1. A method for wireless communication, comprising:

transmitting, by an e-Node B (eNB), information of related to a plurality of Channel State Information Reference Signals (CSI-RS) to a user equipment (UE), wherein the information includes at least one parameter to determine candidate subframes;

transmitting, by the eNB, information indicating locations of a first set of subframes that satisfy a first condition to the UE;

transmitting, by the eNB, the plurality of CSI RSs to the UE using a second set of the candidate subframes that do not satisfy any of one or more predetermined conditions including the first condition, wherein a third set of the candidate subframes, including the first set of subframes, that satisfy any of the one or more predetermined conditions, including the first condition, are not used to transmit the plurality of CSI RSs by the eNB, wherein at least one of the first set of subframes comprises a first portion for control information and a second portion for data, the second portion being subsequent to the first portion in time; and

transmitting, by the eNB, data to the UE through the second portion for data of the at least one of the first set of subframes.

2. The method of claim **1**, wherein the at least one parameter indicates a transmission periodicity and an offset of the candidate subframes.

3. The method of claim **1**, wherein the first set of the subframes comprise MBSFN (Multi-Broadcast Single-Frequency Network) subframes designated for a MBMS (Multimedia Broadcast Multicast Service) service.

4. The method of claim **1**, further comprising:

transmitting information on the third set of the candidate subframes.

5. The method of claim **1**, wherein the third set of the candidate subframes comprises subframes used as a backhaul link for data reception.

6. The method of claim **1**, wherein the third set of the candidate subframes comprises special subframes.

7. A method for wireless communication, comprising:

receiving, by a user equipment (UE), information related to a plurality of Channel State Information Reference Signals (CSI-RSs) from an e-Node B (eNB), wherein the information includes at least one parameter to determine candidate subframes;

receiving, by the UE, information indicating locations of a first set of subframes that satisfy a first condition from the NB;

receiving, by the UE, the plurality of CSI-RSs from the NB using a second set of the candidate subframes that do not satisfy any of one or more predetermined conditions including the first condition, wherein a third set of the candidate subframes, including the first set of subframes, that satisfy any of the one or more predetermined conditions, including the first condition, are not used to receive the plurality of CSI-RSs by the UE, wherein at least one of the first set of subframes comprises a first portion for control information and a second portion for data, the second portion being subsequent to the first portion in time; and

receiving, by the UE, data from the NB through the second portion for data of the at least one of the first set of subframes.

8. The method of claim **7**, wherein the at least one parameter indicates a reception periodicity and an offset of the candidate subframes.

9. The method of claim **7**, wherein the first set of subframes comprise MBSFN (Multi-Broadcast Single-Frequency Network) subframes designated for a MBMS (Multimedia Broadcast Multicast Service) service.

10. The method of claim **7**, further comprising:

receiving information on the third set of the candidate subframes.

11. The method of claim **7**, wherein the third set of the candidate subframes comprises subframes used as a backhaul link for data reception.

12. The method of claim **7**, wherein the third set of the candidate subframes comprises special subframes.

13. A user equipment (UE), comprising:

a circuitry configured to:

cause the UE to receive information related to a plurality of Channel State Information Reference Signals (CSI-RSs) from an e-Node B (eNB), wherein the information includes at least one parameter to determine candidate subframes;

cause the UE to receive information indicating locations of a first set of subframes that satisfy a first condition from the eNB;

cause the UE to receive the plurality of CSI RSs from the eNB using a second set of the candidate subframes that do not satisfy any of one or more predetermined conditions including the first condition, wherein a third set of the candidate subframes, including the first set of subframes, that satisfy any of the one or more predetermined conditions, including the first condition, are not used to receive the plurality of CSI-RSs by the UE, wherein at least one of the first set of subframes comprises a first portion for control information and a second portion for data, the second portion being subsequent to the first portion in time; and

cause the UE to receive data from the NB through the second portion for data of the at least one of the first set of subframes.

14. The UE of claim **13**, wherein the at least one parameter indicates a reception periodicity and an offset of the candidate subframes.

15. The UE of claim **13**, wherein the first set of subframes comprise MBSFN (Multi-Broadcast Single-Frequency Network) subframes designated for a MBMS (Multimedia Broadcast Multicast Service).

16. The UE of claim **13**, wherein the circuitry is further configured to cause the UE to receive information on the third set of the candidate subframes.

17. The UE of claim **13**, wherein the third set of the candidate subframes comprises subframes used as a backhaul link for data reception.

18. The UE of claim **13**, wherein the third set of the candidate subframes comprises special subframes.

19. A communication apparatus, the apparatus comprising:

a circuitry configured to:

cause the apparatus to transmit information related to a plurality of Channel State Information Reference Signals (CSI-RSs) to a user equipment (UE), wherein the information includes at least one parameter to determine candidate subframes;

cause the apparatus to transmit information indicating locations of a first set of subframes that satisfy a first condition to the UE;

cause the apparatus to transmit the plurality of CSI RSs to the UE using a second set of the candidate subframes that do not satisfy any of one or more predetermined conditions including the first condition, wherein a third set of the candidate subframes, including the first condition, that satisfy any of the one or more predetermined conditions, including the first condition, are not used to transmit the plurality of CSI RSs by the apparatus, wherein at least one of the first set of subframes comprises a first portion for control information and a second portion for data, the second portion being subsequent to the first portion in time; and

cause the apparatus to transmit data to the UE through the second portion for data of the at least one of the first set of subframes.

20. The apparatus of claim **19**, wherein the at least one parameter indicates a transmission periodicity and an offset of the candidate subframes.

21. The apparatus of claim **19**, wherein the first set of subframes comprise MBSFN (Multi-Broadcast Single-Frequency Network) subframes designated for a MBMS (Multimedia Broadcast Multicast Service) service.

22. The apparatus of claim **19**, wherein the circuitry is further configured to cause the apparatus to transmit information on the third set of the candidate subframes.

23. The apparatus of claim **19**, wherein the third set of the candidate subframes comprises subframes used as a backhaul link for data reception.

24. The apparatus of claim **19**, wherein the third set of the candidate subframes comprises special subframes.

25. A device for a user equipment (UE), the device comprising:

a circuitry configured to:

cause the UE to receive information related to a plurality of Channel State Information Reference Signals (CSI-RSs) from an e-Node B (eNB), wherein the information includes at least one parameter to determine candidate subframes;

cause the UE to receive information indicating locations of a first set of subframes that satisfy a first condition from the eNB;

cause the UE to receive the plurality of CSI RSs from the NB using a second set of the candidate subframes that do not satisfy any of one or more predetermined conditions including the first condition, wherein a third set of the candidate subframes, including the first set of subframes, that satisfy any of the one or more predetermined conditions, including the first condition, are not used to receive the plurality of CSI-RSs by the UE, wherein at least one of the first set of subframes comprises a first portion for control information and a second portion for data, the second portion being subsequent to the first portion in time; and

cause the UE to receive data from the NB through the second portion for data of the at least one of the first set of subframes.

26. The device of claim **25**, wherein the at least one parameter indicates a reception periodicity and an offset of the candidate subframes.

27. The device of claim **25**, wherein the first set of subframes comprise MBSFN (Multi-Broadcast Single-Frequency Network) subframes designated for a MBMS (Multimedia Broadcast Multicast Service) service.

28. The device of claim **25**, wherein the circuitry is further configured to cause the UE to receive information on the third set of the candidate subframes.

29. The device of claim **25**, wherein the third set of the candidate subframes comprises subframes used as a backhaul link for data reception.

30. The device of claim **25**, wherein the third set of the candidate subframes comprises special subframes.

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